(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 066 962 A2

# (12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
**10.01.2001 Bulletin 2001/02**

(51) Int. Cl.[7]: **B32B 31/20**, B32B 5/00

(21) Application number: **00305682.7**

(22) Date of filing: **05.07.2000**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE**
Designated Extension States:
**AL LT LV MK RO SI**

(30) Priority: **06.07.1999 JP 19229599**

(71) Applicant: **UNI-CHARM CORPORATION**
**Kawanoe-shi Ehime-ken (JP)**

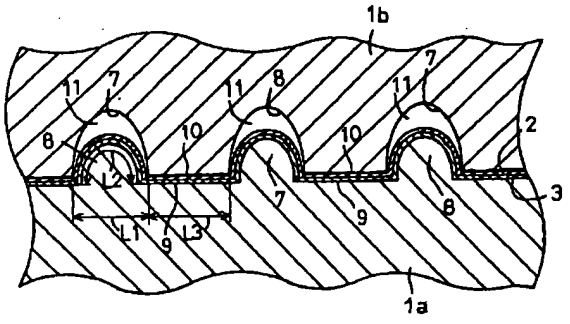
(72) Inventors:
- **Kobayashi, Toshio,**
  **c/o Technical Center**
  **Mitoyo-gun, Kagawa-ken 769-1602 (JP)**
- **Ishikawa, Hideyuki,**
  **c/o Technical Center**
  **Mitoyo-gun, Kagawa-ken 769-1602 (JP)**
- **Mitsuno, Satoshi,**
  **c/o Technical Center**
  **Mitoyo-gun, Kagawa-ken 769-1602 (JP)**

(74) Representative:
**Parry, Christopher Stephen**
**Saunders & Dolleymore,**
**9 Rickmansworth Road**
**Watford, Herts. WD18 0JU (GB)**

## (54) Apparatus and process for making elastic composite sheet

(57) An apparatus and process for making an elastic composite sheet includes a pair of rolls (1a, 1b) adapted to bond respective surfaces of a non-stretchable sheet (2) and a stretchable sheet (3) fed together into a nip of the rolls (1a, 1b). One (1a) of the rolls is formed with ridges (7) while the other roll (1b) is formed with grooves (8) and the ridges (7) are engaged with the grooves (8) with spaces left between surfaces of the ridges (7) and the grooves (8) to form the non-stretchable sheet (2) on its surface with stripe-like crests and flat troughs each defined between each pair of the adjacent crests; and the non-stretchable sheet (2) is bonded along its troughs to the surface of the stretchable sheet (3).

FIG.2




EP 1 066 962 A2

## Description

**[0001]** This invention relates to an apparatus and a process for making an elastic composite sheet.

**[0002]** Japanese Patent Application Disclosure No. 1998-245757 describes a process for making a sheet-like elastic composite comprising the steps of feeding a thermoplastic non-stretchable sheet into a nip between a heat-embossing roll formed on its peripheral surface with stripe-like ridges and grooves and a roll formed on its peripheral surface with the similar ridges and grooves adapted to be engaged with those of the heat-embossing roll to form the non-stretchable sheet with the corresponding ridges and grooves, and feeding a stretchable sheet together with the non-stretchable sheet formed with the ridges and grooves into a nip between the embossing roll and a flat roll to heat-seal the non-stretchable sheet only along the ridges formed thereon with the stretchable sheet.

**[0003]** The process described in the Japanese Patent Application Disclosure No. 1998-245757 requires two separate the steps, i.e., the step of forming the non-stretchable sheet with the ridges and grooves and the step of heat-seal the non-stretchable sheet with the stretchable sheet. On the step of forming the non-stretchable sheet with the ridges and grooves, heat transfer inevitably occurs from the embossing roll and the roll having the ridges and the grooves adapted to be engaged with those of the embossing roll to substantially the whole surface of the non-stretchable sheet. Such heat transfer hardens the non-stretchable sheet and thereby deteriorates a touch expected for this non-stretchable sheet.

**[0004]** It is an object of this invention to provide an apparatus for making an elastic composite sheet enabling the elastic composite sheet to be made through the number of the steps fewer than the prior art has required without deterioration of a touch expected to be presented by the sheet.

**[0005]** According to one aspect of this invention, there is provided an apparatus for making an elastic composite sheet comprising a pair of rolls opposed to each other adapted to bond respective surfaces of a non-stretchable sheet and a stretchable sheet placed one upon another and fed together into a nip of the pair of rolls to each other, wherein:

one of the rolls is formed on a peripheral surface thereof with a plurality of ridges projecting outward radially of the roll and extending circumferentially at predetermined intervals while the other of the rolls is formed on a peripheral surface thereof with a plurality of grooves recessed inward radially of the roll and extending also circumferentially at predetermined intervals; the ridges are engaged with the grooves with spaces left between surfaces of the ridges and the grooves to form the non-stretchable sheet on a surface thereof with a plurality of stripe-like crests extending in one direction and a plurality of flat troughs each defined between each pair of the adjacent crests; and the non-stretchable sheet is bonded along the troughs to the surface of the stretchable sheet.

**[0006]** According to another aspect of this invention, there is provided a process for making an elastic composite sheet comprising a step of feeding a non-stretchable sheet and a stretchable sheet placed one upon another together into a nip of a pair of rolls opposed to each other and thereby bonding respective surfaces of the non-stretchable sheet and the stretchable sheet to each other, wherein:

one of the rolls is formed on a peripheral surface thereof with a plurality of ridges projecting outward radially of the roll and extending circumferentially at predetermined intervals while the other of the rolls is formed on a peripheral surface thereof with a plurality of grooves recessed inward radially of the roll and extending also circumferentially at predetermined intervals and the process comprises the steps of engaging the ridges with the grooves with spaces left between surfaces of the ridges and the grooves to form the non-stretchable sheet on a surface thereof with a plurality of stripe-like crests extending in one direction and a plurality of flat troughs each defined between each pair of the adjacent crests; and bonding the non-stretchable sheet along the troughs to the surface of the stretchable sheet.

**[0007]** The apparatus and process for making the elastic composite sheet as has been described hereinabove is advantageous in that the non-stretchable sheet can be formed on its surface with a plurality of stripe-like crests extending in one direction and a plurality of troughs each defined between each pair of the adjacent crests extending also in the one direction and simultaneously the troughs of the non-stretchable sheet can be bonded to the surface of the stretchable sheet merely by feeding the non-stretchable sheet together with the stretchable sheet into the nip between a pair of rolls. In this way, the elastic composite sheet can be made through the minimum number of the steps. The ridges and the grooves formed on the respective rolls are engaged one with another in non-contact fashion and therefore it is not apprehended that heat might be transferred to the crests of the non-stretchable sheet and deteriorate a touch presented by these crests of the non-stretchable sheet.

Fig. 1 is a perspective view of an apparatus according to this invention for making an elastic composite sheet;
Fig. 2 is a sectional view taken along line A - A in Fig. 1; and
Fig. 3 is a perspective view of the elastic composite sheet obtained by the apparatus and a process according to this invention.

**[0008]** Details of an apparatus according to this invention for making an elastic composite sheet will be more fully understood from the description given hereunder with reference to the accompanying drawings.

**[0009]** Fig. 1 is a perspective view of an apparatus 1 for making an elastic composite sheet and Fig. 2 is a sectional view taken along line A - A to show an important part of the apparatus. Referring to Fig. 1, upstream of the apparatus 1, there are provided feeders 4, 5 of a non-stretchable sheet 2 and a stretchable sheet 3, respectively. Downstream of the apparatus 1, there is provided a take-up roller 6 for a finished composite sheet 12. The apparatus 1 comprises a pair of rolls 1a, 1b vertically opposed to each other.

**[0010]** The lower roll 1a is formed on its peripheral surface with a plurality of ridges 7 projecting outward radially of the roll 1a. The upper roll 1b is formed on its peripheral surface with a plurality of grooves 8 recessed inward radially of the roll 1b and adapted to be engaged with the ridges 7 on the lower roll 1a . The ridges 7 and the grooves 8 extend circumferentially around an axis of the rolls 1a, 1b. With the apparatus 1 of this invention, spaces 11 are left between surfaces of the ridges 7 and grooves 8 when the ridges 7 on the roll 1a are engaged with the grooves 8 on the roller 1b, as will be apparent from Fig. 2. At least one of these rolls 1a, 1b is heated to seal the two sheets 2, 3 with each other. It is also possible to arrange the ridges 7 and the grooves 8 to extend axially of these rolls 1a, 1b.

**[0011]** The non-stretchable sheet 2 and the stretchable sheet 3 are fed from the respective feeders 4, 5 so that the non-stretchable sheet 2 may overlie the stretchable sheet 3. These sheets 2, 3 are laminated with each other in the course defined between the feeders 4, 5 and the apparatus 1 and then enter a nip between the pair of rolls 1a, 1b. In this contact zone defined between the ridges 7 and the grooves 8 on the rolls 1a, 1b, respectively, the non-stretchable sheet 2 lies adjacent the grooves 8 and the stretchable sheet 3 lies adjacent the ridges 7. These sheets 2, 3 are stretched by the ridges 7. The ridges 7 and the groove 8 are not in surface-contact relationship and therefore the non-stretchable sheet 2 is not heat-sealed with the stretchable sheet 3. The non-stretchable sheet 2 and the stretchable sheet 3 are heat-sealed with each other on flat surfaces 9, 10 of the respective rolls 1a, 1b defined between each pair of adjacent ridges 7 and defined between each pair of adjacent grooves 8, respectively.

**[0012]** Having left the apparatus 1, regions of the stretchable sheet 3 having been stretched by engagement between the ridges 7 and the grooves 8 substantially, restore their initial flatness under an elasticity of the sheet 3 while the non-stretchable sheet 2 is formed thereon with a plurality of stripe-like crests 2a extending in one direction. The non-stretchable sheet 2 is formed by the flat surfaces 9, 10 of the respective rolls 1a, 1b between each pair of the adjacent crests 2a with a practically flat trough 2b. These flat troughs 2b of the non-stretchable sheet 2 is heat-sealed with the stretchable sheet 3.

**[0013]** In the apparatus 1, a value corresponding to an arc dimension L2 of the ridge 7 divided by a chord of the ridge connecting opposite ends of the arc should be in a range of 1.5 - 4.5. At the value less than 1.5, the arc dimension of the crest 2a formed on the surface of the non-stretchable sheet 2 would be insufficient to obtain a desired stretch ratio of the composite sheet 12. At the value higher than 4.5, depending on the maximum stretch ratio of the stretchable sheet 3, the crest 2a of the non-stretchable sheet 2 would slacken even after the maximum stretch ratio has been exceeded. Consequently, a touch presented by the non-stretchable sheet 2 would be deteriorated.

**[0014]** In the apparatus 1, a value corresponding to the chord dimension L1 of the ridge 7 divided by a dimension L3 between a pair of the adjacent ridges 7, more specifically, between one end of the one ridge 7 and one end of the adjacent ridge 7 opposed to each other should be in a range of 0.1 - 0.5. At the value less than 0.1, the dimension of the respective flat surfaces 9, 10 formed on the rolls 1a, 1b, respectively, would be insufficient to achieve a reliable sealing between the non-stretchable sheet 2 and the stretchable sheet 3. At the value higher than 0.5, the number of relatively rigid seal lines would increase on the non-stretchable sheet 2 as well as on the stretchable sheet 3, resulting in a deteriorated touch of the composite sheet 12.

**[0015]** A stretch ratio of the composite sheet 12 made by the apparatus 1 can be calculated according to the following equation:

$$\text{Stretch ratio} = \{(L2 + L3/L1 + L3) - 1\} \times 100$$

where

L1 = chord dimension of ridge 7
L2 = arc dimension of ridge 7
L3 = dimension between adjacent ridges 7, 7.

**[0016]** The stretch ratio of the composite sheet 12 should be in a range of 33 - 318 %.

**[0017]** Fig. 3 is a perspective view of the elastic composite sheet 12 made by the apparatus 1. The composite sheet 12 comprises the non-stretchable sheet 2 and the stretchable sheet 3 laminated with each other wherein the non-stretchable sheet 2 is formed thereon with a plurality of the crests 2a extending in one direction and a plurality of the practically flat troughs 2b defined between each pair of the adjacent crests 2a and extending also in the one direction. The non-stretchable sheet 2 is sealed at the troughs 2b with the surface of the stretchable sheet 2 and the crests 2a of the non-stretchable sheet 2 are not sealed with the surface of the stretchable sheet 2. The non-stretchable sheet 2 as

well as the stretchable sheet 3 can be stretched by the arc dimensions of the crests 2a as the composite sheet 12 is stretched transversely of the direction in which the crests 2a formed on the non-stretchable sheet 2 extend.

**[0018]** The non-stretchable sheet 2 may be formed by a nonwoven fabric of thermoplastic synthetic resin fiber. The nonwoven fabric may be selected from those of various types such as spun lace-, needle punch-, melt blown-, thermal bond-, spun bond-or chemical bond-type. The non-stretchable sheet has a basis weight preferably of 15 ~ 80 g/m$^2$, more preferably of 20 ~ 60 g/m$^2$. Component fiber for the nonwoven fabric may be selected from various types of thermoplastic fiber such as polyolefine, polyester and polyamide fibers, and conjugated fiber such as polyethylene/polypropyrene or polyester conjugated fiber.

**[0019]** The stretchable sheet 3 may be formed by elastomer of thermoplastic synthetic resin. The elastomer may be selected from a group including polyolefine, polyester, polyamide and polyurethane elastomers.

**[0020]** Bonding between the non-stretchable sheet 2 and the stretchable sheet may be carried out using the heat-sealing or suitable adhesive such as hot melt adhesive. For the case in which the adhesive is used, the non-stretchable sheet 2 and the stretchable sheet 3 are fed to the apparatus 1 after the opposed surfaces of these two sheets 2, 3 have been bonded to each other. Travelling through the apparatus 1 between the ridges 7 and the grooves 8 thereof, the non-stretchable sheet 2 is forcibly stretched by the ridges 7 and broken. Contraction of the stretchable sheet 3 causes the non-stretchable sheet 2 also to be contracted and thereupon the composite sheet 12 is formed with gathers.

## Claims

1. An apparatus for making an elastic composite sheet comprising a pair of rolls opposed to each other adapted to bond respective surfaces of a non-stretchable sheet and a stretchable sheet placed one upon another and fed together into a nip of said pair of rolls to each other, wherein:

   one of said rolls is formed on a peripheral surface thereof with a plurality of ridges projecting outward radially of said roll and extending circumferentially at predetermined intervals while the other of said rolls is formed on a peripheral surface thereof with a plurality of grooves recessed inward radially of said roll and extending also circumferentially at predetermined intervals;
   said ridges are engaged with said grooves with spaces left between surfaces of said ridges and said grooves to form said non-stretchable sheet on a surface thereof with a plurality of stripe-like crests extending in one direction and a plurality of flat troughs each defined between each pair of the adjacent crests; and
   said non-stretchable sheet is bonded along said troughs to the surface of said stretchable sheet.

2. The apparatus according to Claim 1, wherein a value corresponding to an arc dimension of each said ridge as measured in a section of said rolls divided by a chord dimension of this ridge defined between opposite ends of said arc is in a range of 1.5 - 4.5.

3. The apparatus according to Claim 1, wherein a value corresponding to said chord dimension of said ridge as measured in a section of said rolls divided by a dimension between each pair of the adjacent ridges as measured between adjacent ones of respective ends of these two ridges is in a range of 0.1 - 0.5.

4. The apparatus according to Claim 1, wherein a stretch ratio of said composite sheet as obtained transversely of the direction in which said crests extend is given by an equation:

$$\text{Stretch ratio} = \{(\text{arc dimension of ridge} + \text{dimension between each pair of adjacent ridges as measured between adjacent ones of respective ends of these two ridges/chord dimension of ridge} + \text{said dimension between each pair of adjacent ridges as measured between adjacent ones of respective ends of said two ridges}) - 1\} \times 100;\ \text{and}$$

   said stretch ratio is in a range of 33 - 318 %.

5. The apparatus according to Claim 1, wherein said non-stretchable sheet is formed by a nonwoven fabric of thermoplastic synthetic resin fiber while said stretchable sheet is formed by elastomer made of thermoplastic synthetic resin and said non-stretchable sheet and said stretchable sheet are heat-sealed with each other by said pair of rolls.

6. A process for making an elastic composite sheet comprising a step of feeding a non-stretchable sheet and a stretchable sheet placed one upon another together into a nip of a pair of rolls opposed to each other and thereby bonding respective surfaces of said non-stretchable sheet and said stretchable sheet to each other, wherein:

one of said rolls is formed on a peripheral surface thereof with a plurality of ridges projecting outward radially of said roll and extending circumferentially at predetermined intervals while the other of said rolls is formed on a peripheral surface thereof with a plurality of grooves recessed inward radially of said roll and extending also circumferentially at predetermined intervals, and said process comprises the steps of:
engaging said ridges with said grooves with spaces left between surfaces of said ridges and said grooves to form said non-stretchable sheet on a surface thereof with a plurality of stripe-like crests extending in one direction and a plurality of flat troughs each defined between each pair of the adjacent crests; and
bonding said non-stretchable sheet along said troughs to the surface of said stretchable sheet.

FIG.1

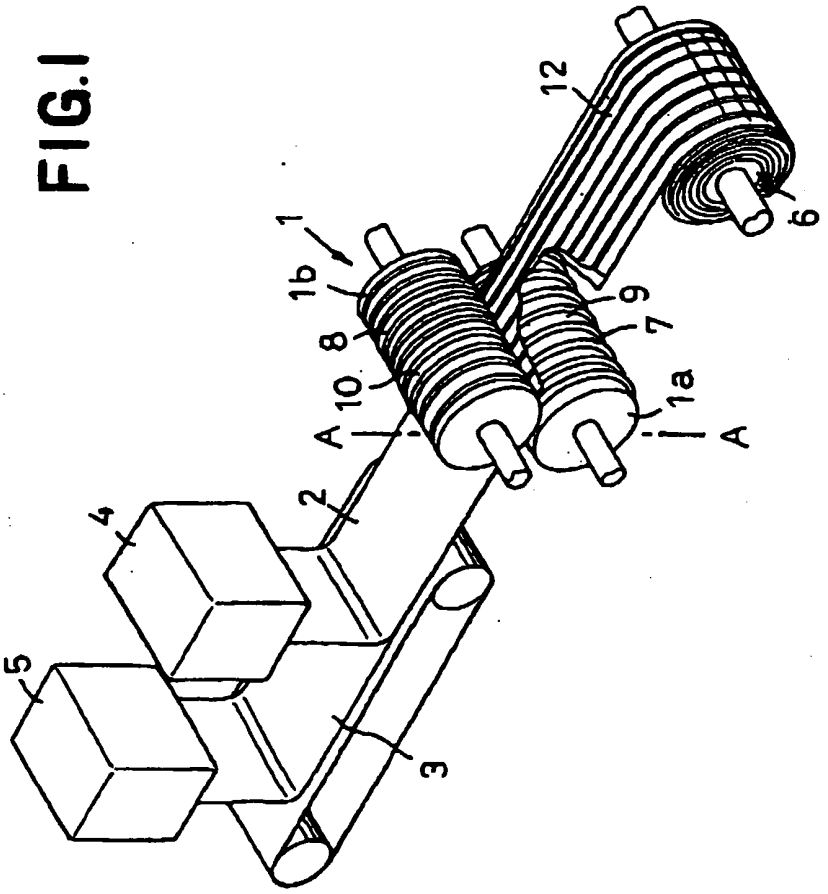


FIG.2

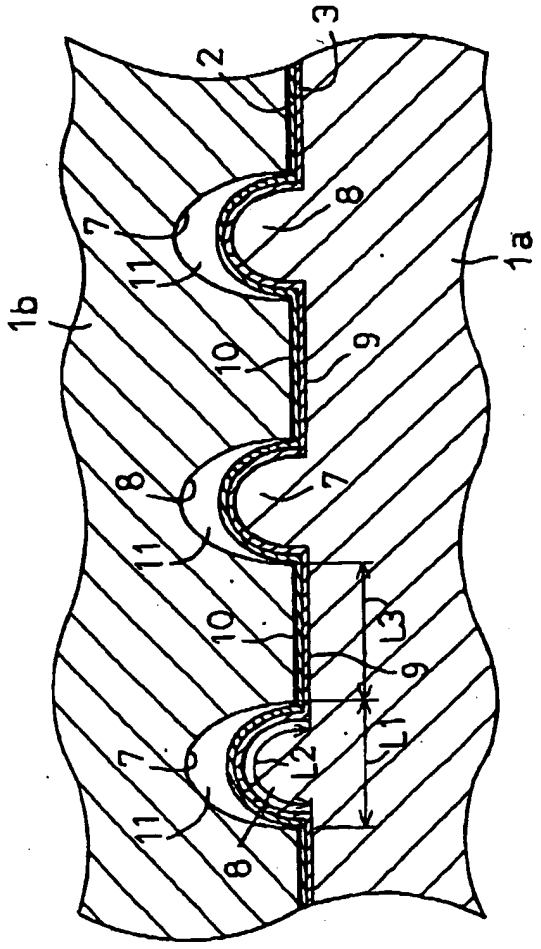


FIG.3